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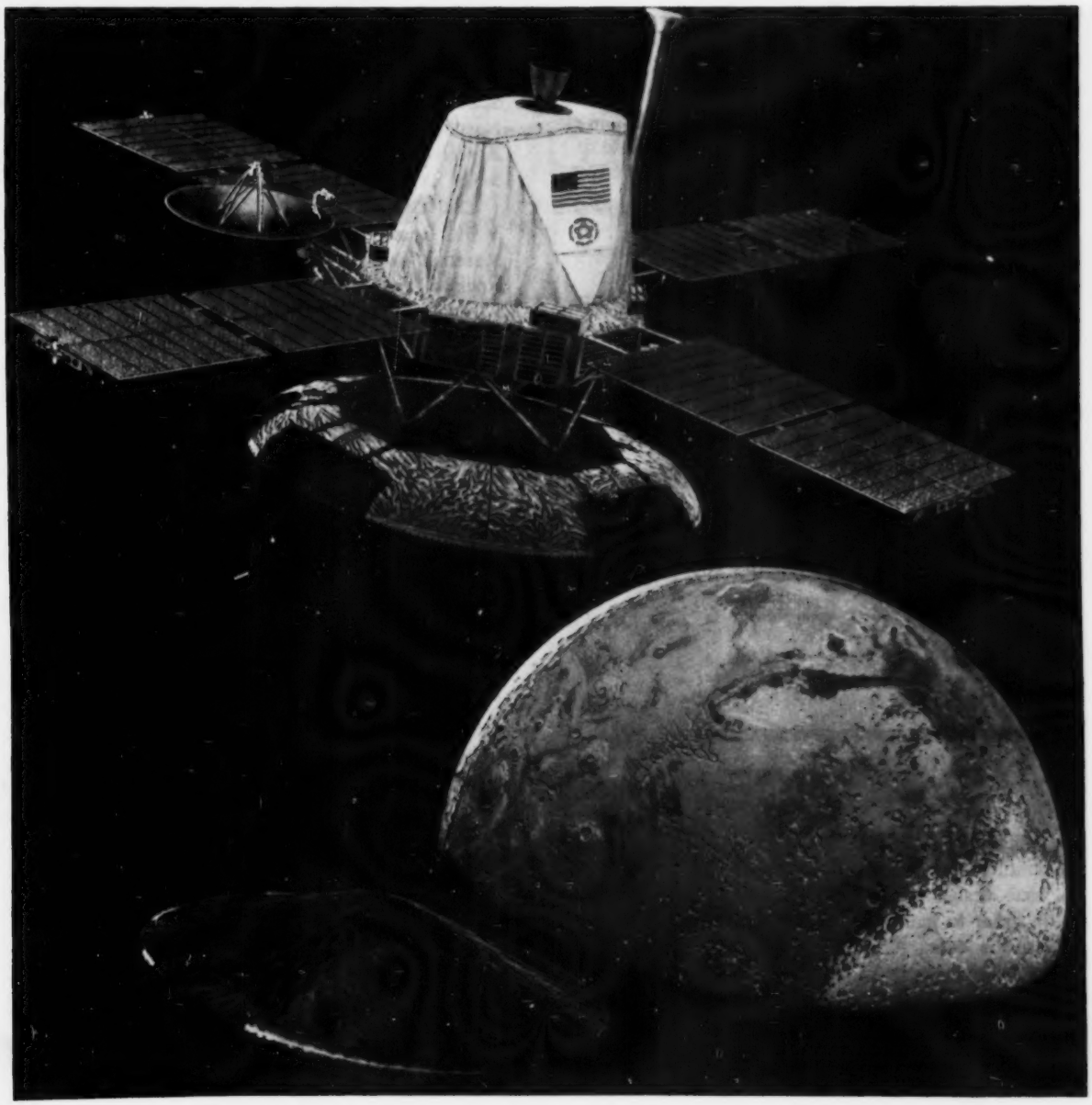

## Cover

This is artist Don Davis' interpretation of the Viking spacecraft arrival at Mars. The Orbiter is shown at the top, with the planet below it. The Lander (bottom), still enclosed in its protective aeroshell, has been released from the Orbiter and is headed for the surface. A parachute will deploy at 20,000 feet, and retrorockets will further slow down the spacecraft for a soft landing.

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# NOTICE

Although NASA ACTIVITIES will be published continuously on a monthly basis, there will be no issue designated "November, 1975." Instead—in order to make the content more current—this issue is dated "December, 1975." This step is taken in an effort to overcome a time lag resulting from the logistics of copy processing and printing.

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# Monthly NASA Highlights

## NASA Experimental Clean Combustor Program

During the late 1960s, as part of the expansion of the Office of Aeronautics and Space Technology's program in aeronautical propulsion, the Lewis Research Center increased emphasis on the identification and understanding of the fundamental pollutant formation processes for low emission gas turbine combustors. By the early 1970s, several in-house combustor concepts had been designed and tested which showed significant emission reduction potential in comparison to in-service aircraft gas turbine combustors.

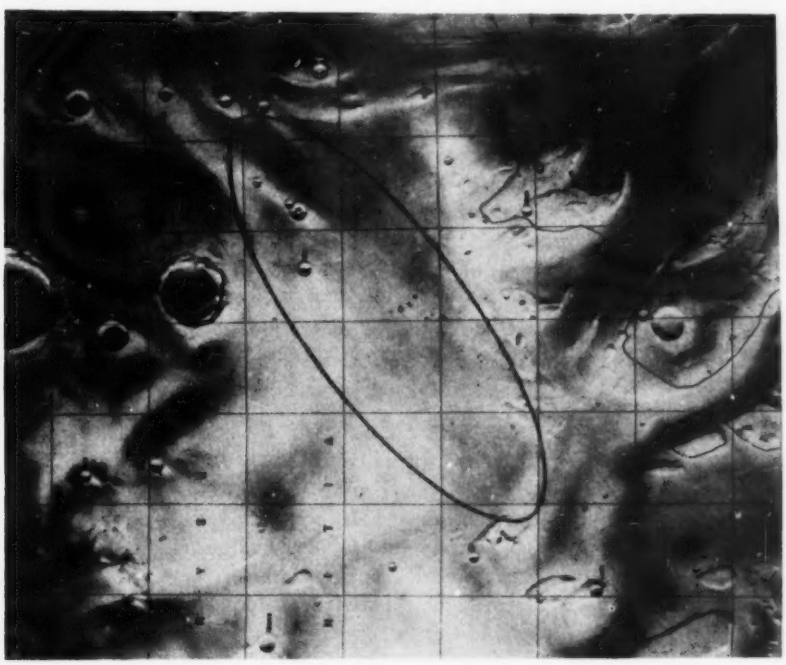
In order to evaluate the many practical aspects involved in design of combustors for application in an engine, a Request for Proposal was issued industry for the conduct of a three-to-four-year effort to be conducted in three phases. The first phase was devoted to screening the many combustor concepts available in NASA, the literature and the industry. The second phase was directed to selection of several of the best concepts, which were then characterized and optimized in test rigs. The third and final phase is to build and test one complete combustor in a full-scale engine.

The program goals for unburned hydrocarbons, carbon monoxide, and nitric oxide were quite ambitious, seeking 75 to 80 percent reductions over current engine emissions. Because of very different concepts proposed by industry in their responses to the RFP, contracts were awarded to both Pratt & Whitney and to General Electric in December, 1972.

Both contractors completed the first two program phases this year. Test results indicate the goal of a 75 percent reduction in unburned hydrocarbon and carbon monoxide can be achieved, but that reductions in nitric oxide emission may be limited to about 50 to 60 percent in this type of aircraft gas turbine engine combustor.

Contracts were recently awarded both contractors for third phase efforts in full-scale engines. P&W will conduct its test in the JT–9D; GE will conduct in the CF–6. Next year at this time, technical reports on this work will be available to industry, the Federal regulatory agencies, and the public.

One of the more important aspects of the Experimental Clean Combustor Program is its potential impact on future emission standards for aircraft engines. It will provide much-needed data required by the Environmental Protection Agency in its determination of the technical and economic implications of imposing such future standards.



**Goal for Viking 1**—The ellipse in this actual photo of Mars indicates the primary landing site for the Viking 1 Lander when it touches down on Mars on July 4 of next year. The site is in a region called Chryse, at the mouth of a 5,000-mile-deep canyon.

## Status of Viking Spacecraft

The Viking 1 and Viking 2 spacecraft, launched Aug. 20 and Sept. 9, respectively, are now well on their way to Mars.

All of the systems on both Orbiters have been checked out and are working satisfactorily. Star field and Earth images taken during the science instrument checkout indicate that the TV cameras are performing better than expected. To date, more than 600 commands have been received and responded to by each spacecraft.

Lander system checkouts will begin in mid-November.

Trajectory status at 1 p.m. Oct. 31 follows:

| | Viking 1 | Viking 2 |
|---|---|---|
| Earth distance (miles) | 140,540,000 | 103,000,000 |
| Earth relative velocity (miles per hour) | 8,000 | 9,100 |
| Mars distance (miles) | 520,200,000 | 550,080,000 |
| Mars relative velocity (miles per hour) | 27,700 | 29,000 |
| Heliocentric velocity (miles per hour) | 69,000 | 70,000 |

The first midcourse maneuver on Viking 1 was accomplished on Aug. 27 with a change in velocity of 15 feet-per-second and on Viking 2 on Sept. 18 with a change in velocity of 26 feet-per-second. No additional corrections will be required until the near approach to Mars.

The spacecraft will encounter Mars on June 19, 1976, and Aug. 7, 1976, respectively. These arrival dates will permit the planned schedule of operations at Mars even though there was a slip of a few days from the scheduled launch dates.

## Virginia Assistant Attorney General Speaks at LaRC

Judith S. Johnson, Virginia Assistant Attorney General, spoke to about 400 employees at the Langley Research Center recently about the impact of Virginia laws on women.

"Historically, women have been protected by the law," she said, "and that protection has not necessarily been good or in their favor. Virginia law, for the most part, is based on common law. Only lately has it moved away from that basis. In the past, the law looked on the woman as a person who had to be protected, and considered the wife as part of the man."

Although distinctions still remain that treat women differently under the law, Johnson says Virginia's Married Women's Act and other laws, such as the Fair Housing Act, have contributed to equality for women. She pointed out that the Equal Credit Opportunity

*Judith S. Johnson*

Act, which went into effect on Oct. 28, should do even more toward ending discrimination against women.

A 1966 graduate of Virginia State College, Johnson says she decided to attend law school after trying unsuccessfully to find a job in the business administration field, her college major. She feels that being a woman was her main difficulty.

The mother of two pre-school girls, she serves as counsel for the state's Division of Personnel, working specifically in the area of equal employment opportunity.

Saying she was unfamiliar with the legal codes in other states, she could not compare the status of Virginia women with women in other states. However, she does think the position of women in Virginia continues to improve.

## Atmosphere Explorer Spacecraft Launched

The Atmosphere Explorer–D (AE–D) spacecraft was successfully launched on Oct. 6, 1975, from the Western Test Range aboard Delta Launch vehicle No. 115, which placed it into an almost elliptical orbit, well within the vehicle performance specifications.

The AE–D, designated Explorer 54, is the second of a series of second-generation spacecraft

designed to extend knowledge of the atmosphere, its energy absorption and its photochemical processes. The scientific payload consists of 12 instruments provided and supported by the United States and foreign universities, the Goddard Space Flight Center, the National Oceanic and Atmospheric Administration, and the Air Force Cambridge Research Laboratory.

The spacecraft is equipped with an on-board propulsion system to permit excursions into the largely unexplored region of the lower thermosphere. It is this region where the bulk of solar energy is absorbed and where most of the chemical and energy conversion processes occur which govern the structures and properties of the upper atmosphere.

## NASA Launches Navigation Satellite for Navy

The Navy TIP–II satellite was successfully launched by a Scout launch vehicle from the Western Test Range on Oct. 12, 1975. The Scout S–195C vehicle performance was nominal and placed the spacecraft in a transfer orbit well within acceptable limits.

The TIP–II satellite is the second in a series of improved Transit navigation satellites. The Transit Program is an operational navigation system used by the U.S. Navy and other vessels for worldwide ocean navigation.

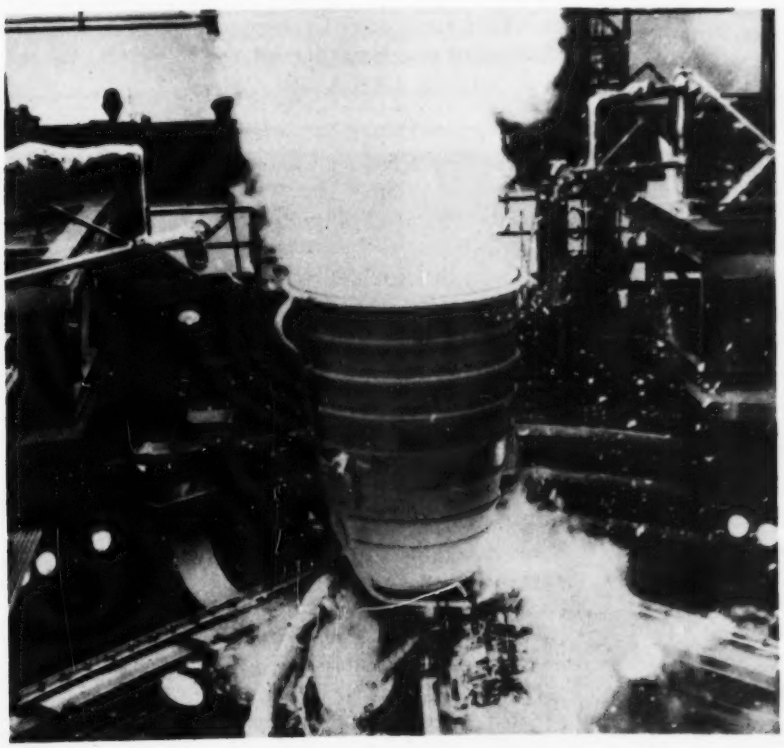
## Geostationary Operational Environmental Satellite Launched

The first operational spacecraft of a series of Geostationary Operational Environmental Satellites (GOES) was launched into orbit from the Eastern Test Range on Oct. 16, 1975, by a Delta 2914 launch vehicle. The Delta placed the GOES–1 spacecraft and the apogee boost motor into the desired transfer orbit.

The GOES project is managed for the Office of Applications by the Goddard Space Flight Center. The Kennedy Space Center is responsible for launch site operations for Delta at the ETR.

The GOES program, a joint effort of NASA and the Department of Commerce, is intended to provide systematic weather coverage on an operational basis. GOES–1 is capable of monitoring simultaneously the Earth and the Sun for real-time storm warnings. The spacecraft will obtain day and night information of nearly one-quarter of the Earth at 30-minute intervals. Radiation sensors monitoring the Sun's flare activity will be used for predicting solar storms that affect radio communications on earth.

Two prototype spacecraft, designated Synchronous Meteorological Spacecraft (SMS–1 and 2), were launched in May, 1974, and February, 1975, respectively, and are operating in orbit. Follow-on GOES spacecraft are planned. ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■



**Shuttle Main Engine Firing**—A photographer caught this picture of frost, formed on the cryogenic propellant ducting, as it shook loose from a test version of the Space Shuttle Main Engine (SSME) during a recent firing at the National Space Technology Laboratories. The 1.6-second firing resulted in the successful ignition of all three combustors and initiation of oxidizer dome prime. The short duration tests, conducted by the Rocketdyne Division of Rockwell International Corp., engine developer, will lead eventually to a full duration firing.

## Space Satellite to Assist Oil Development in Arctic

A space satellite project that could have far-reaching impact on oil recovery operations in Arctic regions will get underway soon.

The Polar Research Laboratory, a company in Santa Barbara, CA, is rushing to completion the fabrication of 16 data collection platforms (DCPs) which can be air-dropped to be used in conjunction with NASA's polar-orbiting Nimbus–6 weather satellite. The DCPs will report on the movement of the Arctic ice pack in the Beaufort Sea just north of Alaska's oil-rich Prudhoe Bay area.

If the project is successful, two firsts will have been achieved—the first day-to-day tracking of ice pack movement in that area and the first successful air-drop of DCPs on ice.

The Nimbus project is the responsibility of Goddard Space Flight Center, while the DCP development is supervised by the National Oceanic and Atmospheric Administration's Data Buoy Office, Bay St. Louis, MS, for the Interior Department's Bureau of Land Management.

The new platforms were designed to meet specifications for the Nimbus–6 onboard Random Access Measurement System, which is capable of contacting and receiving data from more than 1,000 fixed or moving platforms.

Tracking of polar ice is important for many reasons. For instance, in the Beaufort Sea area especially, it is important to know how the winter sea ice interacts with the continental shelf. In addition, during summer, information on why, where and how much ice melts is important.

Known deposits of oil and gas in the Prudhoe Bay land area are 9.6 billion barrels of oil and 26 trillion cubic feet of gas. Another five to 16 billion barrels of oil and 14 to 49 trillion cubic feet of gas, still to be tapped, is believed present on the north slope. Estimates of oil and gas along the continental shelf that extends out into the Beaufort Sea range from two to 19 billion barrels of oil and from five to 50 trillion cubic feet of gas.

It is not known how the ice pack piles up and how far down toward the bottom along the shelf it may reach. Also unknown is precisely where deep Arctic water meets the shallow continental shelf, how fast the ice moves in deep water or how close and how fast it moves toward the shore, where and how much it melts during the short Arctic summer, and many other aspects of the ice pack that have never been monitored on a day-to-day basis.

Knowledge of this nature is important to government and industry alike. Government must know as much as possible about the continental shelf to allocate intelligently drilling areas and oversee their use by private industry. Oil companies want to know the same things for their own exploration plans and to comply with environmental and ecological laws.

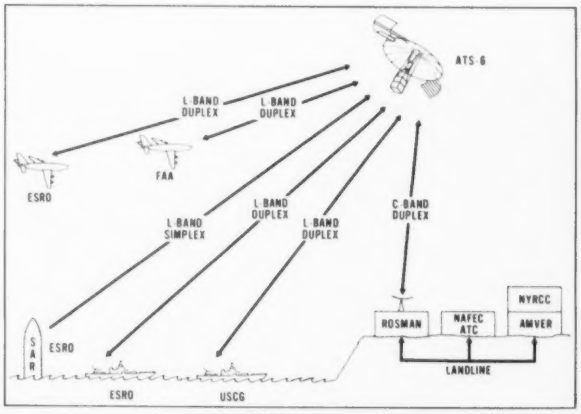
## NASA Satellite Aids in Sea Emergency Operation

*Relays Data To Enable Coast Guard to Rescue Stricken Vessel in Atlantic*

The use of NASA's Applications Technology Satellite–6 (ATS–6) to coordinate a long-distance ship emergency operation in the Atlantic Ocean was described at the 1975 IEEE Electronics and Aerospace Systems Conference held recently in Washington.

The emergency occurred last March near the Portuguese island of the Azores, where staged Search and Rescue (SAR) tests were being conducted as part of an integrated aeronautical/maritime mobile-satellite communications experiment. This experiment is being carried out under the overall supervision of the Goddard Space Flight Center.

Purpose of the SAR tests was to evaluate use of the ATS–6 for directing an emergency operation of all participating vessels and aircraft over a large area by




a U.S. Coast Guard Rescue Coordination Center (RCC) in New York City, thousands of miles from the scene of operations.

A ship not participating in the tests, the *Northern Worker,* received rudder and engine damage during a storm the night before. Its long-distance radio equipment also was out of order.

The U.S. Coast Guard cutter *Gallatin,* participating in the tests near the distressed vessel, radioed the

RCC in New York via the ATS–6 satellite. Details of the problem, ship's location and status were included in the communication. This gave the RCC the required data necessary to proceed with a rescue, if necessary.

Upon completion of the three-hour tests, during which the RCC kept a constant vigil on the stricken ship, the Coast Guard vessel escorted the *Northern Worker* safely to port in the Azores.

For the staged Search and Rescue tests, the German nuclear ship *Otto Hahn* deposited an emergency Position Indicating Radio Beacon (PIRB) buoy in the ocean. Immediately, the buoy began transmitting the *Otto Hahn's* call letters on L-Band frequencies, those established for aeronautical and maritime mobile satellite communication. The buoy also generated homing signals for ships and aircraft.

From its station 22,300 miles overhead, the two-ton ATS–6 immediately relayed the buoy's L-band signals to a NASA ground station at Rosman, NC. From there, the signals were immediately sent to the Coast Guard's New York rescue center.

No sooner had the signals erupted from a speaker in the center than a Coast Guardsman identified the vessel by its call letters. He then determined its most probable location. Quickly, calls went out over the ATS–6 to the *Otto Hahn* and the U.S. Coast Guard cutter *Gallatin*.

The Coast Guardsman at the RCC then called the Federal Aviation Agency's Oceanic Air/Traffic Control Center in Atlantic City, NJ, which directed the two aircraft to the rescue scene. Again the ATS–6 was used as a communications relay between the FAA controller and the aircraft. The aircraft included an FAA K–135 and a Comet plane belonging to the European Space Agency.

Within two hours after the first signal was transmitted from the buoy, the two ships and aircraft located and recovered the test buoy.

According to Dr. William N. Redish, Chief of the Communications and Navigation Division at Goddard, "these tests clearly demonstrated the value of satellites in long-distance search and rescue operations outside normal maritime and aeronautical radio range."

Ships and aircraft not in direct line of sight of land must rely on high frequency radio communications. Such signals are generated over long distances by being bounced back and forth between the Earth's surface and the ionosphere, an electrically charged sheath encircling the globe. Due to its method of relay and atmospheric conditions, high frequency radio communications often are unreliable.

Certain very high frequencies less affected by atmospheric conditions have been allocated for aeronautical and maritime mobile-satellite communications. These frequencies are designated the L-Band (1.5 to 1.7 gigahertz) and involve line-of-sight signals to and from satellite.

The search and rescue communications tests with the ATS–6 are a continuing part of an L-Band experiment being conducted by the Goddard Space Flight Center and the U.S. Departments of Commerce and Transportation, as well as by the European Space Agency and the Canadian Department of Communications and Ministry of Transport.

**Former NASA Official Visits MSFC**— Dr. George Mueller (right, President of Systems Development Corp., Santa Monica, CA, and former NASA Associate Administrator for Manned Space Flight, recently visited the Marshall Center for an inspection of the image processing system installed there under a NASA contract by his company. Shown with him is Douglas Thomas, MSFC contracting office representative for the project.

# Did You Know?

**Nine members and guests of the Heavy Duty Truck Manufacturers Association (HDTMA)** met with Marshall Space Flight Center researchers recently to discuss the possibilities of transforming space technology to the trucking industry.

The primary purpose of the one-day session was to acquaint HDTMA with MSFC's capabilities and areas of expertise, as well as to formulate statements indicating the trucking industry's problem areas.

**Public drive-through tours of the Kennedy Space Center** and adjacent Cape Canaveral Air Force Station, suspended Aug. 17 because of a labor grievance involving a concessionaire that resulted in the closing to the general public of Gate 2 on State Road 3 on Merritt Island, have been resumed. A resolution of the grievance by the National Labor Relations Board led to the removal of picket lines.

**Business and industry have been asked** by the Marshall Space Flight Center and the Energy Research and Development Administration to submit proposals for development of solar energy heating and cooling systems and subsystems for both residential and commercial buildings.

**Eight Soviet scientists met with U.S. experts** on the remote sensing of geology and agriculture at Sioux Falls, SD, during October for discussions that are part of the joint effort by NASA and the Soviet Academy of Sciences to advance studies of the Earth from space.

**NASA has given approval to Rockwell International Corp.** to begin final design and construction of two subscale models of a highly-maneuverable aircraft incorporating advanced technologies for potential future manned aircraft. They will be flown by Flight Research Center in a joint NASA/USAF program to develop advanced technology for high maneuverability using new technology from various technical disciplines.

**Nine experiments involving the processing of materials in near-weightlessness** have been selected to be carried aboard an unmanned sounding rocket scheduled for launch in early December. They were chosen from a total of 62 proposals from scientists in industry, government and universities.

The rocket flight will be the first of a five-year-old series in a new Space Processing Applications Rocket (SPAR) project managed by the Marshall Space Flight Center.

**Kennedy Space Center has awarded a $179,928 contract** to Reynolds, Smith and Hills, Inc., Jacksonville, FL, for architectural and engineering services in connection with modifications to the Payload Changeout Room to be constructed at Complex 39's Pad A.

The Payload Changeout Room is one of the new structures planned to modify the pad for Space Shuttle launches, beginning in 1979.

**National Employ the Handicapped Week** was observed Oct. 5-11 at the Marshall Space Flight Center, where 178 handicapped persons, including 11 women and 134 veterans, are employed. During the last 12 months, MSFC has promoted three handicapped persons and presented awards to 22. ■ ■ ■ ■ ■ ■ ■ ■

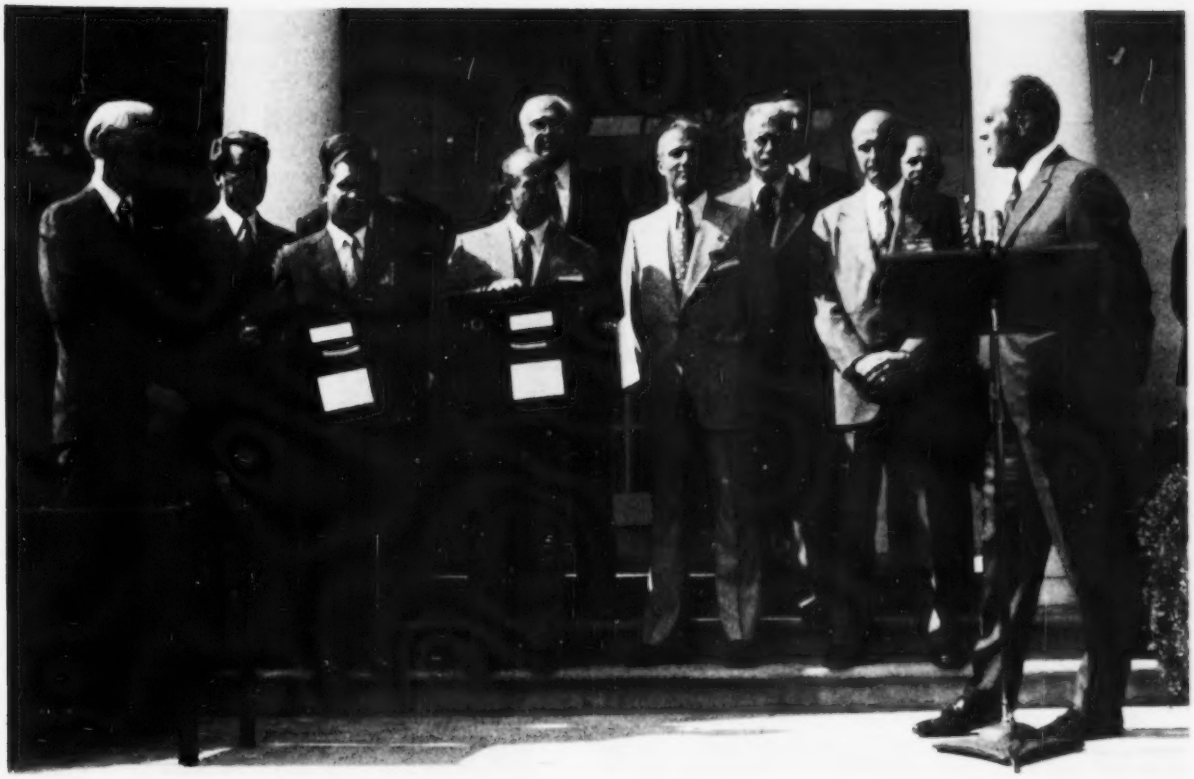
## President Ford Again Greets ASTP Astronauts and Cosmonauts

Members of the crews of both the Apollo and Soyuz spacecraft who took part in the ASTP mission were greeted by President Ford at the White House on Oct. 13 at the start of their recent 10-city tour of the United States.

The President's words of greeting follow:

"Obviously, I am extremely delighted to have the opportunity to greet each of the astronauts and cosmonauts, this time on Earth. As I recall, we talked together last July. At that time you were making great history and our conversation was at the range of about 140 miles from the Earth itself. It was a great occasion with the Apollo and Soyuz being linked at the same time. But let me say that this is a great demonstration, what took place, because it shows that there can be and there is cooperation between the United States and the Soviet Union in the area of space. But actually the handshake, in my opinion, was far, far more significant than the talk that had been going on prior to the operation.

"But even more significant, of course, was the activity of literally thousands and thousands of scientists, technicians, and others in putting together over a three-year period a successful effort, which shows what can be done between the people and the governments of two great nations. And this joint effort, I hope and trust,



**White House Gathering**—President Ford, far right, is shown as he greeted the Apollo Soyuz Test Project crews on their recent visit to the White House. With him, left to right, are Dr. James C. Fletcher, NASA Administrator; Lt. Gen. Vladimir A. Shatalov, Deputy Director of Cosmonaut Training; Cosmonaut Valeriy N. Kubasov; Cosmonaut Brig. Gen. Aleksey A. Leonov; Ambassador Anatoliy Dobrynin; Astronaut Vance Brand; Astronaut Donald K. Slayton; Nicholas Timacheff, NASA interpreter; Astronaut Maj. Gen. Thomas P. Stafford; and John P. Donnelly, NASA Assistant Administrator for Public Affairs.

will be but a forerunner of what we can do on an expanded basis, not only in space and science but in many other areas.

"Now when the Space Shuttle becomes operational at the turn of the decade, we will be on the threshold of even greater opportunities, a new era in space activity. These reusable space vehicles will provide effective as well as economical means to utilize and build upon our capabilities in space. Already there are commercial, as well as scientific itnerests, involved in making use of what this potential shows for us.

"The history books, of course, that will be written in the years ahead will recognize that these five individuals were really great pioneers in an effort between these two countries. And it indicates—or the history books will indicate—that this was the beginning, and hopefully a good beginning, of this new era before us."

## Half Million View NASA Overseas Exhibits

Overflow crowds damaged restraining walls in the U.S. pavilion as they pressed to take part in a communications demonstration using NASA's Applications Technology Satellite 6 (ATS–6)—a special attraction at the Third International Astronautical Exhibition held this fall in Belgrade, Yugoslavia.

On the island of Okinawa, half way around the world, models of NASA spacecraft used in studies of ocean and weather relationships drew more than 450,000 visitors at the International Ocean Exposition, Expo 75.

The display in Belgrade, presented by the U.S. Information Agency with NASA assistance, stressed applied space technology—in keeping with the fair's overall theme of "space for peace." Some 30 countries, including the Soviet Union, India, Peru, Indonesia and Ghana, participated in the exhibition.

The purpose of the U.S. exhibit was to portray America's continuing leadership in the exploration of space, with emphasis on the many benefits provided by advanced space technology. Guides discussed Earth resources, communications, and meteorological satellites while visitors examined photographs and models or watched live demonstrations.

A full-size model of LANDSAT, space imagery of

**Scenes at NASA Exhibit Abroad**—The photo at left is an aerial view of the United States pavilion at Expo '75 on Okinawa, while that at the lower left is of the promenade leading to it. Below is shown an array of NASA spacecraft for ocean studies, one of the features of the exhibit.

Yugoslavia, and weather photographs received by automatic picture transmission equipment on loan from Goddard Space Flight Center generated substantial interest at the fair.

The hit of the Belgrade exhibition was the demonstration of ATS–6 color television and telephone transmission. Two three-meter antennas mounted on the pavilion marquee transmitted and received color television pictures from a camera in the hall. Two television monitors displayed the picture before and after transmission, dramatically illustrating the quarter-second delay as the picture traveled to and from ATS–6.

"The crowd would wait over an hour for the satellite demonstration to begin," reported Charles W. Mathews, Associate Administrator for Applications. Telephone signals also were simultaneously transmitted and received through ATS–6.

An estimated 90,000 persons visited the U.S. pavilion, and each of the 5,800 who conversed through ATS–6 received a Space Communicator Certificate to record their participation.

Four model spacecraft—LANDSAT, Skylab, Nimbus and Geosat—dominated the U.S. display in Okinawa. They were designed to tell the story of how the oceans and the weather interact, as well as how technology is making it possible to predict weather more accurately.

"Thanks to NASA's participation," wrote Charles H. Clarke of the United States Information Agency after Expo 75 had ended, "the U.S. pavilion at the International Ocean Exposition in Okinawa, Japan, has been widely acclaimed as the best in presenting the most significant and relevant approach to the Expo's oceanic theme."

## Speaker Says Shuttle Payloads Promise Far-Reaching Effects

*MSFC Program Development Director Gives Talk at U.S.-European Space Conference*

The Zero–G Atmospheric Cloud Physics Laboratory (ACPL) could be one of the more important developments to emerge from the space program, James T. Murphy, Director of Program Development at the Marshall Space Flight Center, told attendees at the Sixth U.S.-European Space Conference recently held at Monte Carlo.

He said experiments using the ACPL are expected to yield information which could lead to weather modification, including hail suppression, fog dissipation, precipitation (rain or snow) control, and hurricane abatement.

The two main themes of the conference were Applications Satellites and Space Applications Payloads.

In his address, Murphy discussed the First Spacelab Mission, the ACPL, the Space Processing Laboratory, and the Atmospheric, Magnetospheric and Plasmas in Space (AMPS) payloads. MSFC has study responsibility for these four Shuttle payloads.

"NASA is confident," Murphy said, "that these payloads will meet the needs of the user (scientific) community and that they will make significant contributions to their respective areas of science for many years."

NASA's current planning indicates, he added, that 226 Spacelab flights will be needed to accommodate the requirements of the user community during the 1980s.

According to Murphy, many scientists have been involved in planning the types and frequencies of sortie missions needed to satisfy their discipline objectives.

Payloads for Spacelab are classified generally as "exclusive-user" and "multi-user." The first are those in which a single NASA Center provides or controls the entire payload, while the latter are those for which more than one Center provides experiment equipment.

The First Spacelab Mission and the Zero–G ACPL are multi-user payloads, but the AMPS and Space Processing payloads could eventually be flown as exclusive-user payloads.

NASA and the European Space Agency agreed that the following experimental objectives should have prime consideration for the first spacelab mission:

- Implement active and inactive experiments in the Earth's atmosphere and magnetosphere to investigate key natural causes and effects of relationships in the near-Earth environment.
- Demonstrate the capability to investigate the fundamental science of vapor, liquid and solid phase interactions under gravity-free conditions.
- Investigate the effects of the space environment on body fluid redistribution, vestibular function, growth, development and organization of living systems (man, cells, tissues).

The first objective can be realized by flying several precursor versions of AMPS instruments. Data obtained, valuable scientific information in itself, would be useful in configuring the AMPS payload better to accomplish its scientific objectives.

The second objective can be partially achieved by taking along some early zero-g cloud physics experiments. Precursor experiments in life sciences can satisfy the third objective.

Thus, Murphy stressed, the First Spacelab Mission affords the opportunity to accomplish "a meaningful science program at a reasonable cost and, at the same time, provide the requisite knowledge for configuring more comprehensive payloads for future flights."

Discussing the ACPL, Murphy said microphysical processes within large-scale cloud patterns produce embedded showers, thunderstorms and squall lines.

"Obtaining quantitative information on these processes will lead to a better understanding of the microphenomena of cloud physics which is a prerequisite to accurate short-range weather predictions," he added.

The mission of the ACPL, he continued, is "to make gravity-free cloud microphysical observations practical, productive and economically feasible. Conceived as a reusable, general-purpose laboratory, it will be open to experimenters within and outside the government."

Processes responsible for initiation and growth of water droplets, hail and snowflakes will require "extensive investigation if significant advances are to be made in weather modification," the speaker stressed.

Objectives of the Space Processing Applications (SPA) program are: (1) to develop space processing payloads to accommodate applied research on economically viable materials technology and industrial processes in space; and (2) to turn out products that cannot be produced on Earth or that can be improved greatly by being processed in space.

Past SPA experiment programs have had international participation. Experiments from Europe and Japan were in MSFC's multipurpose electric furnace on Skylab, and the Apollo Soyuz Test Project (ASTP) flight had samples from other countries and a complete payload from Germany.

"The research accomplished in the Space Processing payload," Murphy said, "will enable us to perfect techniques for preparing purer biologicals (such as vaccines), structurally improved semiconductor crystals for electronics applications, and unique glasses as well as metallurgical products.

"A detailed economic analysis in the biological area has indicated that this area appears to be very promising from an economic viewpoint."

The AMPS Scientific Definition Working Group which began operations in 1974 includes members from Canada, England, France, Germany, Japan, The Netherlands, Norway and Sweden. Several technology areas have been identified and are being studied.

Orientation of the AMPS payload is toward the study of those mechanisms which influence and control the Earth's environment. Scientists hope to come to understand the causes of communication blackouts, the effects of contaminants on the atmosphere (ozone depletion), solar-weather relationships, and other phenomena.

**Giant Map Draws Attention**—This map of the contiguous 48 states, assembled from 595 cloud-free, black and white images returned from NASA's LANDSAT-1, is a popular exhibit in the lobby of the Marshall Space Flight Center headquarters building. Shown checking points of interest on an atlas are, left to right, Pat Burrow, Shelvie Miller, Annette Hunt and Shirley Langford, all MSFC employees.

## Space Book Is Republished

*Space—Its Impact on Man and Society* by Lillian Levy, Senior Science Writer and Assistant Director of the Public Services Division, has been republished by Books for Libraries Press, Inc.

Although first published in 1965, the book is remarkably current and still in demand at schools and libraries. Many of the predictions made within its pages

with respect to space exploration and technology, as well as policy and programs, have only recently become fact.

Books for Libraries Press is at 1 Dupont St., Plainview, NY 11803. The republished volume, a hardback edition, is priced at $12.50.

The author recently again became the first and only woman nominated for the Board of Directors at Comsat's annual shareholders' meeting. Twice before she had received this distinction.

## Nordberg and Brockman Receive Pecora Award

Two scientists who contributed significantly to the success of the LANDSAT program were presented the William T. Pecora Award during a scientific symposium at Sioux Falls, SD, Oct. 28-31.

They are Dr. William Nordberg, Project Scientist of the LANDSAT program at the Goddard Space Flight Center, and Dr. Carlos Brockmann, Director of the LANDSAT-Bolivia Project.

Established in 1974, the award, honoring the memory of Dr. Pecora, Director of the U.S. Geological Survey and Under Secretary of the Department of the Interior, is unique in government in that it is sponsored jointly by two major Federal agencies, NASA and the Department of the Interior. It is given annually in recognition of "outstanding contributions of individuals or groups toward the understanding of the Earth by means of remote sensing."

While Dr. Nordberg's major contributions to LANDSAT have been in the field of meteorology, he is now responsible for managing the day-to-day research operations of the LANDSAT 1 and 2 satellites.

Dr. Brockman formed a multidisciplinary team of scientists in Bolivia to evaluate and apply LANDSAT images. Within a year, the team had produced nearly 20 evaluation reports covering geology, volcanology, forestry, hydrology, and land use, each demonstrating positive uses for Bolivia.

## Agreement on Aviation Safety Reporting Signed

NASA has signed an agreement with the Federal Aviation Administration to act as a "third party" for the purpose of receiving, processing and analyzing reports of unsafe conditions or practices filed under FAA's Safety Reporting Program.

The new reporting system will modify the program announced earlier this year under which reports were filed directly with FAA.

"The third party agreement," said James F. Dow, Acting FAA Administrator, "should assure everyone that the FAA's only objective in this program is to provide the safest possible aviation system by identifying and correcting unsafe conditions before they lead to accidents. It should therefore further stimulate the free and unrestricted flow of information."

The agreement contains specific procedures to provide for the protection of the identity of persons involved in reports submitted to NASA, except in those cases involving alleged criminal conduct or accidents.

The new reporting system is scheduled to be in operation by next April, with details to be spelled out in a Federal Register notice and an advisory circular to be

issued by FAA. In the meantime, reports will continue to be filed directly with FAA.

The agreement calls for the NASA Office of Aeronautics and Space Technology to set up an aviation safety reporting work group under its Research and Technology Advisory Council to advise NASA on the system's design and operation, to evaluate and review the program once it is underway, and to assure that the confidentiality of those submitting reports is maintained. Its membership will include aviation and consumer groups, as well as others involved in the operational aspects of the national aviation system.

NASA's effort will be managed by Dr. Charles Billings of Ames Research Center.

## MSFC Appoints Team to Aid in Increasing U.S. Coal Output

A team of engineers to work with the Bureau of Mines in using expertise and technology of the space program to increase the nation's annual coal output has been established at the Marshall Space Flight Center.

In announcing the team, to be known as the Advanced Mineral Extraction Task Team and to be headed by Robert E. Pease, Dr. William R. Lucas, Center Director, said it will operate within the Program Development Directorate. A Memorandum of Understanding recently was signed with the Department of the Interior.

One of the first goals will be to improve the efficiency of the long-wall shearer, a machine used in mines to shear coal from the vein. It is operated by a miner usually in poor light and in a confined area thick with coal dust. As presently employed, it may leave as much as a foot or more of coal along the edges of a vein, causing thousands of tons to be left in the ground.

The team plans to develop sensors and TV monitors to automate and remotely control the machine, enabling it to "sense" the edge of the vein and take out all the coal without touching the surrounding earth or shale.

In commenting on the team's efforts, Pease said: "We are taking some of the essential first steps to increase the annual coal output from 600 million tons to the 1.25 billion tons it is estimated the nation will need in the 1980s."

## MSFC Resumes Tests to Improve Shuttle Design

The testing of a scale model of the Space Shuttle has resumed at the Marshal Space Flight Center to provide information needed for the design of the Space Shuttle and its launch facilities.

Acoustic model tests are being conducted on a 6.4 per cent scale model of the Shuttle, complete with liquid-fueled engines and solid rocket motors, to study the effects of sound waves on the Space Shuttle and its launch pad.

The tests also give engineers information on the temperature effects of the hot exhaust gases on the aft portion of the Shuttle immediately after ignition.

## Materials Processing Payloads Discussed

Scientists and engineers from government, industry, and universities met recently at the Marshall Space Flight Center to develop design requirements for Space Shuttle and Spacelab payloads to conduct experiments in applied materials research in the early 1980s.

Such payloads will be developed and flown in NASA's Space Processing Applications (SPA) program to initiate materials research and development activity in Earth orbit. The SPA program is intended to develop applications of space flight that will advance materials science and technology, eventually leading to orbital manufacturing operations.

The meeting was the first in a series of five scheduled to be held at MSFC during the next six months.

## Rockwell Gets Solid-State Recorder Contract

The Rockwell International Corp., Anaheim, CA, has been awarded a $1.5 million contract to develop a solid-state, bubble-memory data recorder for NASA.

This type of recorder has no moving parts, a distinct advantage over the magnetic tape recorder, which stops working when the tape breaks. The solid-state is segmented in such a way that, if a single part gets out of order, the unit continues to operate at a reduced capacity.

The key qualities of the solid-state are high reliability, versatility and low cost. It will have a microprocessor controller and will be designed to meet a wide variety of spacecraft data storage requirements. Its capacity will be about 100 million bits.

The cost-plus-fixed-fee contract, covering a period of about two and a half years, will be managed by Langley Research Center.

## Workshop Explores Handling of Liquified Natural Gas

NASA's experience in handling cantankerous cryogenic rocket propellants, such as liquid oxygen and liquid hydrogen, appears to have great potential as a tool for controlling the vast quantities of liquified natural gas (LNG) the nation will need in the years ahead.

A Risk Management System developed at Kennedy Space Center already is being adapted on a pilot basis by the New York City Fire Department to provide guidelines for handling and storing LNG.

This application and other potential contributions in numerous fields were explored during a two-day Risk

**Workshop Press Conference**—These men answered questions from the press following a recent Risk Management Workshop held at the Kennedy Space Center. Left to right, they are John P. Claybourne, KSC; William N. Parsons, Boeing/KSC; Otto H. Fedor, KSC; Louis N. Mogavero, NASA Headquarters; and Commissioner John O'Hagan, New York City Fire Department.

Management Workshop held recently at KSC. The sessions were attended by 74 representatives of government and industry, among them Commissioner John O'Hagan of the New York City Fire Department.

O'Hagan told of the support and cooperation his department has received from NASA and KSC in the wake of a 1973 disaster that took the lives of 42 persons at the Staten Island LNG facility. He and his department have been working with a KSC study team since early 1974 in adapting the Risk Management System's procedures to prevent a repetition of the catastrophe.

Use of imported LNG—a volatile, super-cooled liquid stored at 256 degrees below zero Fahrenheit—is expected to soar in the coming years as domestic sources of natural gas are depleted. Estimates from the Cryogenic Data Center of the Natural Bureau of Standards predict a jump from current LNG usage of about two million cubic feet annually to about two trillion by 1980.

Transforming natural gas into a liquid reduces its volume by a factor of 600 to one, making its transportation and storage in the liquid state a much safer proposition. The availability of a Risk Management System as exemplified by the techniques developed at KSC will provide cities and industries with a safe, systematic approach to dealing with LNG, according to Raymond J. Cerrato, KSC's Technology Utilization Officer.

Among the panelists was Louis N. Mogavero, Acting Director of the Technology Utilization Office at NASA Headquarters, under the auspices of which the workshop was held. Other participants included John P. Claybourne, Otto Fedor, Frederick B. Schoenberger and Edward M. Dickinson, all of KSC; William N. Parsons, Boeing/KSC; Ira C. Stanfill, American Gas Association, and S. F. Felder, Lewis Research Center.

## NEBA Program Reviewed for Management

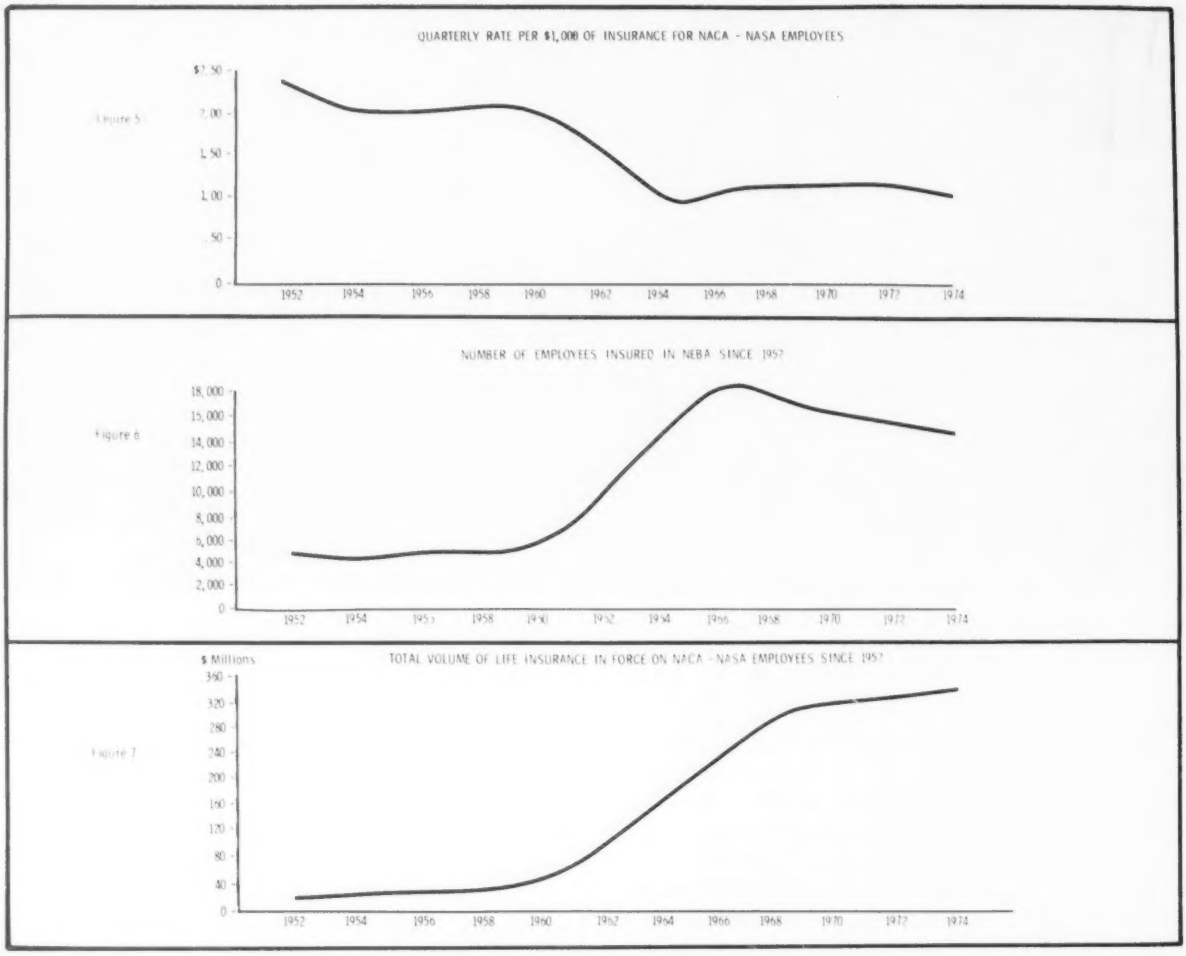
A new first in the agency's history was added recently when an overview of the NASA Employees Benefit Association (NEBA), dating back to its beginning more than 23 years ago, was given before a General Management Review held at Headquarters.

The presentation was made by James T. McCrystal, Senior Vice President of the Home Life Insurance Co. of New York, by which NEBA is underwritten.

In his opening remarks, he termed the NEBA program "outstanding," adding: "It has worked soundly and effectively; it is healthy and sound today; and it is continuing to do its job well."

Since the program was begun, he reported, it has paid families of employees of both NASA and its predecessor, the National Advisory Committee on Aeronautics (NACA), more than $16,250,000 in benefits.

"I know of no other group life insurance program covering government employees on an employee pay-all basis," he said, "that has ever even partially succeeded




in achieving its objectives, much less succeeded, so well as your own NASA program has."

McCrystal recalled that, back in 1950, a group of NASA employees at the Lewis Flight Propulsion Laboratory (now Lewis Research Center) at Cleveland began talking over the possibility of buying life insurance on a basis that would give them a discount if they could get a sufficient number of their fellow workers to buy life insurance. Eventually, bids were secured from 33 of the largest life insurance companies in existence. A committee set up to study them selected Home Life as the underwriter.

Dr. Hugh Dryden, Director of NACA, signed a contract with Home Life, effective March 25, 1952, and established NEBA to administer the plan and insure its stability and growth.

Three objectives were laid out for the program at the start: (1) to provide employees with adequate amounts of group term life insurance; (2) at low, reasonable costs; and (3) supported by continuing consistent high quality service.

Only Lewis employees were enrolled during the first three months of 1952. After that, Home Life representatives began enrollments at Headquarters and at the Ames and Langley Research Centers. At the end of the first year, 4,700 employees were participating for a volume of $20 million. The premuim for the first year amounted to a little more than $150,000.

During NEBA's existence, its Board of Directors has had only four Chairmen—William M. Shea, George McCauley, William M. Thompson and, since 1972, Ralph E. (Mike) Cushman of Headquarters.

Over the years, according to McCrystal, the program has improved so that it today provides two and a half times as much life insurance as it did originally. It also provides accidental death and dismemberment coverage at no additional cost.

"Your plan provides substantial protection at very low cost," McCrystal said in summary. "It is in very sound financial shape now and, if the management of your NEBA Board of Directors continues as prudent in the future as it has in the past, there is every reason to believe the excellent results achieved to date will continue to be achieved in the years ahead."

**Women's Program Meeting**—Members of the Marshall Space Flight Center Federal Women's Program Advisory Committee were photographed recently as they met with Oceola Hall, agency-wide Federal Women's Program Coordinator. Shown left to right are (seated) Jimmie Dew, Ms. Hall and Bonnie Holmes; standing left to right, Pauline Watson, Paula Rainey, Bernice Choate and Sandra Dickerson.

## Balloons Aid in Gathering Weather Data

Some 150 fixed, floating and airborne instrument platforms—balloons—are transmitting information on tropical and polar weather, as well as ocean and ice conditions, to NASA's newest and most sophisticated meteorological research satellite, Nimbus–6, circling the Earth in a north-south orbit at an altitude of 1,104 kilometers (660 miles).

In coming months, 1,000 or more Earth-girdling platforms will be deployed to transmit information to investigators in Australia, Brazil, Canada, France, Norway, South Africa and the United States. Data will be returned from such remote places as the South Pole, Indian Ocean, Africa, Samoa and the Arctic.

Information from all platforms is transmitted to the satellite, which records the data on tape recorders and then, on command from either Fairbanks, AK, or Rosman, NC, plays back the information to the station below. From there, the data are sent to the Goddard Space Flight Center to be disseminated by investigators.

Nimbus-6 was launched by a Delta rocket from the Western Test Range June 12. The mission was officially declared successful Sept. 12.

**Arctic Ice Explorer**—This is one of 16 data collection platforms (DCP) to be air-dropped in conjunction with the Nimbus-6 weather satellite to report on the movement of the Arctic ice pack in the Beaufort Sea just north of Alaska's oil-rich Prudhoe Bay area.

## Orbiter Acceptance Checkout Equipment Contract Let

An $11.5 million contract to provide Acceptance Checkout Equipment (ACE) for the Space Shuttle Orbiter has been awarded by NASA to the General Electric Co. division of Houston, Tx.

The ACE system will be used to conduct standard tests and procedures and detect variances in spacecraft systems while they are in assembly at the Orbiter plant at Palmdale, CA. Under terms of the contract, GE also will provide checkout support during the approach and landing phases of the Shuttle missions.

Approximately 30 GE personnel will be employed under the contract at Palmdale and an additional 80 at the Johnson Space Center.

Rockwell International, Inc., is responsible for the fabrication and integration of the Orbiter at Palmdale.

## Chile to Build LANDSAT Ground Station

Under an agreement recently announced by NASA, the University of Chile will build and operate a ground station designed to receive Earth resources data from the LANDSAT spacecraft.

This will be the tenth station planned or completed around the world. The others are in Alaska, California, Maryland, Brazil, Canada and Italy.

Until the Chilean station becomes operational, the University of Chile will use the NASA Spaceflight Tracking and Data Network station at Santiago to acquire LANDSAT data. According to the agreement, use of this facility will not interfere with NASA operations, while the university will bear any expense required for additional equipment or operations there.

## NASA, Coast Guard to Develop Fire-Fighting Module

The U.S. Coast Guard and NASA jointly have undertaken a project to design and build a prototype lightweight, portable fire-fighting module for use in combating shipboard and dock fires.

The module will be a completely self-contained pumping system, capable of being lifted by helicopter or dock crane onto the deck of almost any type of boat. It will carry its own pumps, hose, fire-fighting suits and other necessary equipment, and will be able to pump water from the sea at a rate of up to 2,000 gallons per minute for periods of up to three hours.

Now in the design phase at the Marshall Space Flight Center, construction of the prototype is expected to start early next year, with tests of the module to begin about 18 months later. If successful, it is expected eventually to be made available commercially to fire departments throughout the country.

**Skylab Group Achievement Award**—After William C. Schneider (right), Deputy Associate Administrator for the Office of Space Flight (OSF) and former Skylab Program Director, had presented each of the 96 Headquarters recipients with the Skylab Group Achievement Award, he himself received one from John H. Disher, Director of Advanced Programs in OSF. The certificate reads in part: ". . . in recognition of their exceptional competence, resourcefulness, and dedication in providing outstanding management support to the Skylab Program . . . ."

## Carbon Monoxide Found on Jupiter

A joint Jet Propulsion Laboratory-University of Texas astronomy team has detected carbon monoxide in the atmosphere of the planet Jupiter for the first time.

Presence of a trace quantity of carbon monoxide in the planet's lower atmosphere was established by high-resolution spectra obtained by instruments used in conjunction with the 2.7-meter telescope at the university's McDonald Observatory in Austin.

Spectral lines, the signature readings of various molecules, clearly disclosed that carbon monoxide molecules were present to a depth of at least 50 kilometers (30 miles) into the lower atmosphere of Jupiter—equal to a pressure of about two Earth atmospheres.

Dr. Reinhard Beer of JPL, leader of the team, said the spectra showed no indication of carbon dioxide in the Jovian atmosphere. He suggested that future telescopic search from higher altitudes might also reveal carbon dioxide.

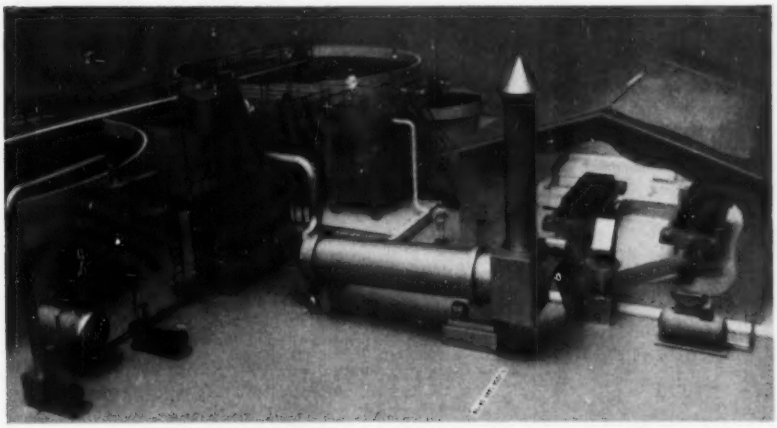
Carbon monoxide now has been found in minor amounts on four planets. The others are Earth, Mars and Venus.

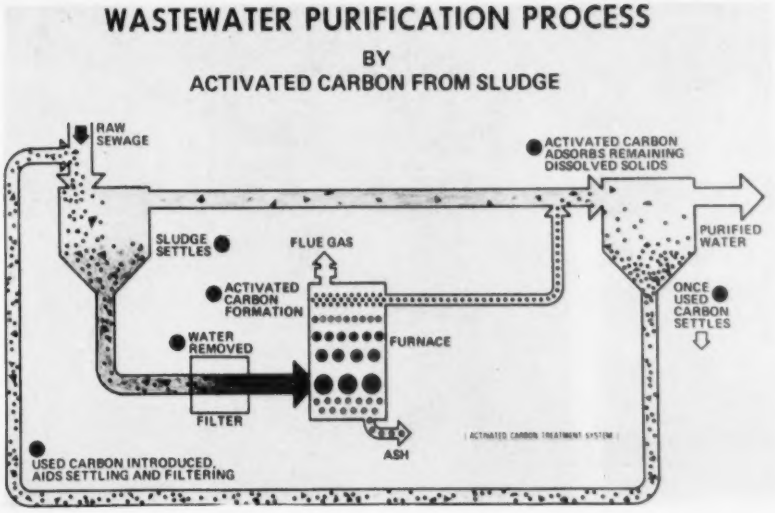
## Soviet Satellite to Carry NASA Life Sciences Experiments

For the first time, U.S. experiments will be flown on board a Soviet spacecraft.

Dr. David L. Winter, NASA Director for Life Sciences, recently announced that, during the recent Joint U.S.-USSR Working Group meetings on space biology and medicine, plans were completed for U.S. experiments to be carried on an unmanned Soviet biological satellite expected to be launched late this year.

Four NASA-developed life sciences experiments are involved. In addition, seven tissue investigations will be conducted by U.S. scientists on materials supplied by the Soviets from their animal experiments, six of them involving rat tissues and the other Drosophila (flies).






**Wastewater Purification Process**—The tabletop model at left is of a sewage treatment plant that uses a new process developed by the Jet Propulsion Laboratory. The system virtually eliminates sewage solids, delivers cleaner wastewater, and may save large quantities of money by upgrading existing facilities to meet future national standards. Heart of the system is a pyrolytic reactor to activate carbon, which in turn treats the incoming wastewater. At right is a drawing of the process. Construction of a 1,000,000-gallon-a-day municipal plant will be begun this year in Southern California.

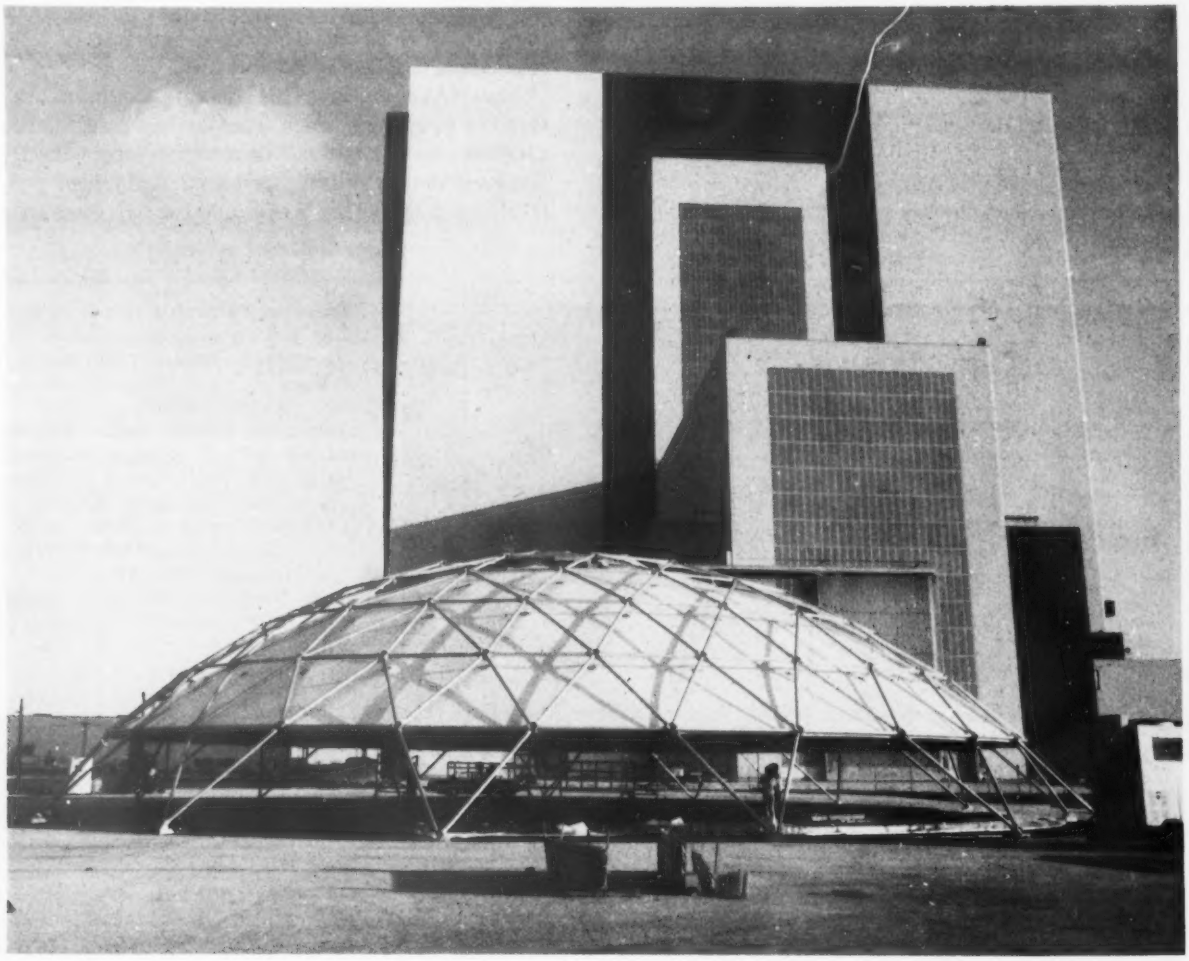
## First Dome for Bicentennial Exposition Erected at KSC

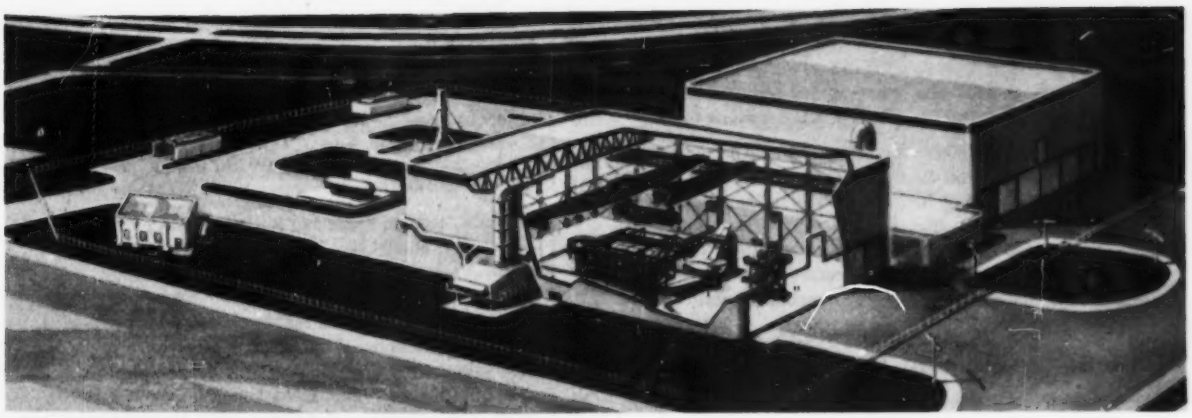
The first geodesic dome for the National Science and Technology Exposition, presently scheduled to be open approximately 100 days during the summer of 1976, has been erected on the south side of the Vehicle Assembly Building (VAB) at Kennedy Space Center.

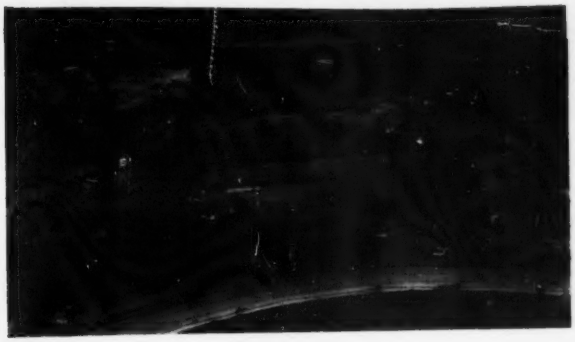
KSC was designated the host site for the exposition by President Ford. The theme for the attraction will be the future of science and technology and the application of modern technology to improving the quality of life on Earth.

All government agencies involved with science and technology have been asked by the President to contribute to the exposition. It is expected that 15 or more of the domes, which measure 120 feet in diameter and are 30 feet tall, will be needed to house the exhibits.

Edward S. Simmons of the Department of Commerce has been appointed General Manager for the exposition at NASA Headquarters. Paul C. Donnelly is KSC Project Manager.





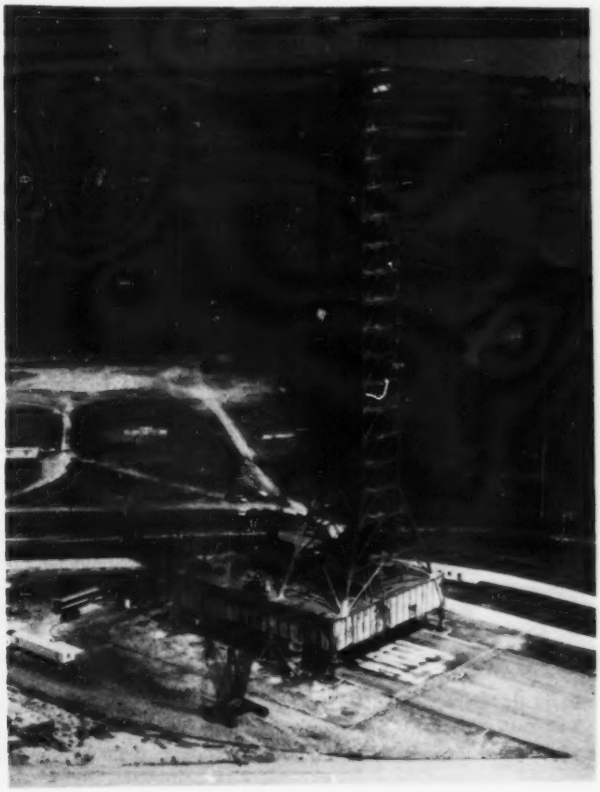


**Shuttle Construction Moves Ahead at KSC**—Space Shuttle facilities are beginning to reshape the face of the Kennedy Space Center.

The artist's concepts shown in the two upper illustrations are of the Orbiter Processing Facility (OPF) and of a Shuttle landing. Construction of the OPF, as indicated in the photograph at bottom left, already has begun.

At left, the Shuttle runway stretches far into the distance, while the towway bends around to the left foreground. The pouring of concrete for the runway is nearing completion.

Below, right, a Mobile Launcher stands ready for the modification work which will ready it for use at Pad A during the Shuttle era.



## Radio-Television

(Released Nationally)

TELEVISION—A color film release in the *Aeronautics and Space Report* monthly series: "Firefighter's Breathing System."

RADIO—Four weekly *Space Story* programs have been released: "Viking-Mars Landing Sites," (USGS/Masursky); "Viking Entry Science," (Harvard U/Dr. McElroy); "Viking Mars Surface Pictures," (Brown U/Dr. Mutch); and "ASTP Post Flight," (JSC/Astronaut Stafford). One monthly *NASA Special Report*, "ASTP Post Flight Crew Reports," (featuring astronauts and cosmonauts). One set of ten 60-second announcements, *NASA Space Notes.*

## Lunar Sample Exhibits

*The following is a schedule of lunar sample exhibits from Nov. 15 to Dec. 15, 1975:*

**Illinois**—University of Chicago, Nov. 8-15.
**Maryland**—Johns Hopkins University, Baltimore, Nov. 20-21.
**Pennsylvania**—Lycoming County Historical Museum, Susequehanna, Nov. 14-16.
**Virginia**—Langley NASA Space Exhibit, Fairfax, Nov. 3-22; Richlands Area Chamber of Commerce, Dec. 9.

**American Freedom Train**—Reno, NV, Nov. 13; Sacramento, CA, Nov. 18; San Francisco, CA, Nov. 25; Fresno, CA, Dec. 9.
**High Flight Foundation-Bicentennial Mobile Space Museum**—Cleveland, TN, Nov. 11-16; North Carolina, Nov. 18-23; Macon, GA, Nov. 25-30; South Carolina, Dec. 2-7; Jacksonville, FL, Dec. 9-14.

### Long Term Displays

**Alabama**—Alabama Space and Rocket Center, Marshall Space Flight Center, Huntsville.
**Florida**—Visitor Information Center, Kennedy Space Center.
**Kansas**—Eisenhower Library, 200 SE 4th Street, Abilene.
**New York**—United Nations Building, New York City.
**Ohio**—USAF Museum, Wright Patterson AFB.
**Texas**—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston.
**Virginia**—Visitor Information Center, Langley Research Center, Hampton.
**Washington, DC**—National Geographic Museum; Smithsonian Institution, National Air and Space Museum, 1000 Jefferson Drive; Washington National Cathedral.

## Patents for Inventions from NASA Research

*(The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.)*

| Inventor(s) and Employer(s) | Title and NASA Docket | Patent No. | Installation |
|---|---|---|---|
| Albert J. Juhasz and Richard W. Niedzwiecki, NASA/LeRC | Controlled Separation Combustor (LEW-11,593-1) | 3,910,035 | LeRC |
| Anthony Fortini, NASA/LeRC | Rocket Chamber and Method of Making (LEW-11,118-2) | 3,910,039 | LeRC |
| Garry J. Cleveland, George M. Loh, Robert S. Luce, M. I. Lipanovich and Howard L. Peterson, all of Lockheed Missiles & Space Co., Sunnyvale, CA; Donald W. Mangold, Boeing Co., Pasadena, TX; and Norman Belasco and Sam L. Pool, NASA/JSC | Medical Subject Monitoring System (MSC-14,180-1) | 3,910,257 | JSC |
| Donald C. Cheatham and Richard A. Reid, NASA/JSC | Spacecraft Docking Alignment System (MSC-12,559-1) | 3,910,533 | JSC |
| Hoyt McBryar, NASA/JSC | Reconstituted Asbestos Matrix (MSC-12,568-1) | 3,910,814 | JSC |
| Fred Jankowski,, NASA/MSFC | Quick Disconnect Filter Coupling (MFS-22,323-1) | 3,910,307 | MSFC |
| Miles O. Dustin, NASA/LeRC | Shock Position Sensor for Supersonic Inlets (LEW-11,915-1) | 3,911,260 | LeRC |
| Jacob D. Broder, NASA/LeRC | Covered Silicon Solar Cells (LEW-11,065-2) | 3,912,540 | LeRC |
| Marvin Perlman, Caltech/JPL | Nonlinear Nonsingular Feedback Shift Registers (NPO-13,451-1) | 3,911,330 | NaPO |
| Willard W. Anderson and Nelson J. Groom, NASA/LaRC | Annular Momentum Control Device Used for Stabilization of Space Vehicles and the Like (LAR-11,051-1) | 3,915,416 | LaRC |
| Shimer Z. Pinckney, NASA/LaRC | Static Pressure Probe (LAR-11,552-1) | 3,914,997 | LaRC |
| Bruce A. Banks, NASA/LeRC | Apparatus for Forming Dished Ion Thruster Grids (LEW-11,694-2) | 3,914,969 | LeRC |
| Robert H. Silver and Sarkis H. Kalfayan, Caltech-JPL | Strain Gage Mounting Assembly (NPO-13,170-1) | 3,914,991 | NaPO |
| Tage O. Anderson, Caltech/JPL | Multi-Computer Multiple Data Path Hardware Exchange System (NPO-13,422-1) | 3,916,380 | NaPO |
| Ervin R. Wiebe, Caltech/JPL | Helium Refrigerator (NPO-13,435-1) | 3,914,950 | NaPO |
| Katsunori Shimada, Caltech/JPL | Thermostatically Controlled Non-Tracking Type Solar Energy Concentrator (NPO-13,497-1) | 3,915,148 | NaPO |

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|---|---|---|---|---|
| Neal L. Roy, Systems Group of TRW, Inc., One Space Park, Redondo Beach, CA | Cosmic Dust Analyzer (MSC-13,802-2) | 3,916,187 | JSC |
| Gordon L. Fogal, General Electric Co., Philadelphia, PA, and Richard L. Sauer, NASA/JSC | Automatic Biowaste Sampling (MSC-14,640-1) | 3,915,012 | JSC |
| William J. Britz and William A. Boshers, NASA/MSFC | Rapid Activation and Checkout Device for Batteries (MFS-22,749-1) | 3,912,541 | MSFC |
| James R. Currie, NASA/MSFC | Voltage Controlled Oscillator (MFS-22,924-1) | 3,914,712 | MSFC |
| James R. Rollings, Rockwell International Corp. Canoga Park, CA | Externally Supported Internally Stabilized Flexible Duct Joint (MFS-19,194-1) | 3,915,482 | MSFC |

## Projected Launch Schedule

*(As of Oct. 20, 1975)*

| Name | Launch Date | Vehicle | Range | Mission Remarks |
|---|---|---|---|---|
| RCA-A | Dec. 11 | Delta | ETR | First of a series of domestic communications satellites for RCA. Reimbursable. |
| **1976** | | | | |
| CAS-C/CTS | Jan. 13 | Delta | ETR | Canadian-US cooperative experimental communications satellite to develop and test the technology of high power satellite communications systems. |
| Helios-B | Jan. 15 | Titan III Centaur | ETR | Second West German/NASA cooperative satellite to investigate the properties of and processes in interplanetary space close to the Sun. |
| Intelsat IVA-B | January | Atlas Centaur | ETR | Second of a series of improved Intelsat consortium satellites. Reimbursable. |
| ITOS-E2 | January | Delta | ETR | Operational meteorological satellite of the National Weather Service to provide daytime and nighttime cloud cover imagery. Reimbursable. |
| NATO-C | February | Delta | WTR | Communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable. |
| Marisat-A | February | Delta | ETR | Comsat Corp. satellite to provide maritime communications services. Reimbursable. |
| LAGEOS | 1st Qtr. | Delta | WTR | Demonstrate relevant space techniques that will contribute to the development and validation of predictive models for earthquake hazard alleviation, ocean surface conditions and ocean circulation. |
| RCA-B | 1st Qtr. | Delta | ETR | Second domestic communications satellite for RCA. Reimbursable. |
| Relativity (Gravity Probe) | (Under Study) | Scout | WTR | Scientific satellite to make a test of Einstein's Theory of Relativity. |
| Comstar-A | 1st Qtr. | Atlas Centaur | ETR | Domestic communications satellite for Comsat Corp. Reimbursable. |
| Intelsat IVA-C | May | Atlas Centaur | ETR | Third of a series of improved Intelsat Consortium satellites. Reimbursable. |
| Marisat-B | 2nd Qtr. | Delta | ETR | Second Comsat Corp. satellite to provide maritime satellite communications services. Reimbursable. |
| Comstar-B | 2nd Qtr. | Atlas Centaur | ETR | Second domestic communications satellite for Comsat. Reimbursable. |
| Indonesia-A (Palapa) | 3rd Qtr. | Delta | ETR | Indonesian communications satellite. Reimbursable. |
| RCA-C | 2nd Half | Delta | ETR | Third domestic communications satellite for RCA. Reimbursable. |
| GOES-B | 4th Qtr. | Delta | ETR | Second operational satellite to provide continuous daytime and nighttime global cloud cover observations for NOAA. Reimbursable. |
| ITOS-H | 4th Qtr. | Delta | ETR | Operational meteorological satellite to provide daytime and nighttime cloud cover imagery for NOAA. Reimbursable. |
| Comstar-C | 4th Qtr. | Atlas Centaur | ETR | Domestic communications satellite for Comsat. Reimbursable. |
| Navy Transit | 1976 | Scout | WTR | Navy navigation satellite. Reimbursable. |

## NASA Tech Briefs

**The Technology Utilization Office, NASA Headquarters**

*(The following is a listing of published NASA Tech Briefs. Inquiries concerning them should be directed to the TU Office of the originating NASA Center.)*

| Innovator(s) | Title | Number | Center |
|---|---|---|---|
| Robert A. Jones, LaRC, and R. F. Romanowski and I. H. Steinberg, Grumman Aerospace Corp. | New Method for Determining Thermophysical Properties of Test Specimens | B73-10447 | LaRC |
| W. A. Brainard and D. H. Buckley, LeRC | Scanning-Electron-Microscope Used in Real-Time Study of Friction and Wear | B75-10064 | LeRC |
| Alvin E. Buggele, LeRC | Diffusion Pump Modification Promotes Self-Cleansing and High Efficiency | B75-10065 | LeRC |
| W. E. Winters and P. J. Cavano, TRW Equipment | Fabrication of Composite Fan Blades Using PMR A-Type Polyimide Resin and Graphite Fiber Reinforcement | B75-10066 | LeRC |
| Glen E. McDonald, LeRC | Survey of Coatings for Solar Collectors | B75-10067 | LeRC |
| J. A. Plumer and L.C. Walko, General Electric Co. | A Test and Measurement Technique for Determining Possible Lightning-Induced Voltages in Aircraft Electrical Circuits | B75-10068 | LeRC |
| Manfred N. Wirth, ARC | High-Speed Data Word Monitor | B75-10129 | ARC |
| Peter E. Dannenberg, ARC, and Peter I. Slapnicar, Stanford University | Computer Modeling of Arc Drivers | B75-10130 | ARC |
| Ira R. Schwartz, ARC | Minimization of Jet and Core Noise by Rotation of Flow | B75-10131 | ARC |
| Robert A. Ormiston, William G. Bousman, Dewey H. Hodges and David A. Peters, ARC, and U.S. Army Air Mobility R & D Laboratory | New Design of Hingeless Helicopter Rotor Improves Stability | B75-10132 | ARC |
| Richard Binder, University of Hawaii | Multiplexing Techniques for Computer Communications via Satellite Channels | B75-10133 | ARC |
| R. J. Parker and E. V. Zaretsky, LeRC | Silicon Nitride Used as a Rolling-Element Bearing Material | B75-10134 | LeRC |
| Lewis Research Center | Design Criteria Monograph on Turbopump Systems | B75-10135 | LeRC |
| Technology Application Center, University of New Mexico | Wind Energy Utilization: A Bibliography | B75-10136 | LeRC |
| T. T. Serafini and R. D. Vannucci, LeRC | Tailor Making High Performance Graphite Fiber Reinforced PMR Polyimides | B75-10137 | LeRC |

**On Loan from Air Force**—Two such planes as the one shown in this photograph, the F-15, have been lent NASA by the U.S. Air Force and will be flown by the Flight Research Center to help the designers of future jet fighter-type aircraft. The program is aimed at determining the cause for discrepancies between predicted and actually measured aerodynamic drag.

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|---|---|---|---|
| W. F. Stuhrke, J. L. Carpenter, Jr., and N. Moya, Martin Marietta Aerospace, and G. Mandel, LeRC | Life Prediction of Materials Exposed to Monotonic and Cyclic Loading: A Technology Survey and Bibliography | B75-10138 | LeRC |
| W. F. Stuhrke, J. L. Carpenter, Jr., and N. Moya, Martin Marietta Aerospace, and G. Mandel, LeRC | Fracture Toughness Testing Data: A Technology Survey and Bibliography | B75-10139 | LeRC |
| William J. Borucki, Don H. Card and Gilbert C. Lyle, ARC | Method of Identifying Clusters Representing Statistical Dependencies in Multivariate Data | B75-10140 | ARC |
| Dennis A. Johnson, ARC | Laser Velocimeter Measurements of High-Speed Compressible Flows | B75-10141 | ARC |
| G. N. McEwen, Jr., National Research Council, and Bill A. Williams, ARC | Quick-Change Absorption Column | B75-10142 | ARC |
| Ralph E. Gabrielsen and Steven Karel, ARC | Algorithm for Nonlinear Stationary Navier-Stokes Problem | B75-10143 | ARC |
| William M. Congdon, Martin Marietta Corp. | Reflecting Heat Shields Made of Microstructured Fused Silica | B75-10144 | ARC |
| Ray N. Lanham, Charles E. Taylor, Carl E. Balmer and Chintsun Hwang, Northrop Corp./Aircraft Division | Mounting Technique for Pressure Transducers Minimizes Measurement Interferences | B75-10145 | ARC |
| John D. Newell, Robert A. Keller and Norman A. Baily, University of California, San Diego | Simple Computer Method Provides Contours for Radiological Images | B75-10146 | ARC |
| R. L. Thomas, R. L. Puthoff, J. M. Savino and W. R. Johnson, LeRC | An Experimental 100 Kilowatt Wind Turbine Generator | B75-10147 | LeRC |
| Robert T. McKenna, GSFC | Digital Tape Drive Monitor | B75-10153 | GSFC |
| C. L. Canicatti, KSC | Voltage Monitoring System | B75-10154 | KSC |
| IBM Corp. | Remote File Inquiry (RFI) System | B75-10155 | KSC |
| William W. Ho, Allan W. Love and Marinus J. Van Melle, Rockwell International Corp. | Nondestructive Measurement of Capillary Tube Internal Diameter | B75-10156 | LaRC |
| G. M. Wood, LaRC, B. T. Upchurch, Old Dominion University, and D. B. Hughes, E. I. du Pont de Nemours and Co. | Determination of Water Content Using Mass Spectrometry | B75-10157 | LaRC |
| Loyd Wayne Overbay, LaRC | Angular Device for Optical Filters | B75-10158 | LaRC |
| G. M. Wood, LaRC, B. T. Upchurch, Old Dominion University, and D. B. Hughes, E. I. du Pont de Nemours and Co. | Dynamic Delta Method for Trace Gas Analysis | B75-10159 | LaRC |
| Theodore R. Creel, Jr., and Robert A. Jones, LaRC, and Richard R. Corwin and Joseph S. Kramer, Beta Industries, Inc. | Automated Electronic System for Measuring Thermophysical Properties | B75-10160 | LaRC |
| G. A. Baily, MSFC, and L. S. Cosentino, RCA Corp. | Page Composer to Translate Binary Electrical Data to Optical Form | B75-10161 | MSFC |
| J. T. Eliason, Sperry Rand Corp. | Zener-Regulated Solar Array/Battery Power System | B75-10162 | MSFC |
| L. B. Holderman, National Research Council | Fabrication of Porous Plugs for Control of Liquid Helium | B75-10163 | MSFC |
| J. R. Lager and B. Burke, Martin Marietta Corp. | Fabrication and Repair of Graphite/Epoxy Laminates | B75-10164 | MSFC |

**Saturn-Shuttle Conversion**—Another piece of Saturn hardware is being drafted for use in the Space Shuttle program. The F-1 engine vertical installer was shipped from the Marshall Space Flight Center to the Rocketdyne Division of Rockwell International Corp. for modification. It later will go to the National Space Technology Laboratories for use in installing Space Shuttle Main Engines on the Main Propulsion Test Article.

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|---|---|---|---|
| D. E. Melton and W. R. Humphries | Solar Residential Heating and Cooling System | B75-10165 | MSFC |
| M. I. Radnofsky and J. Naimer, JSC | Highly-Visible Air-Sea Rescue Marker | B75-10166 | JSC |
| P. W. Jones, C. Aldridge, Jr., J. T. Holen, R. D. Vannest and S. F. Gibson, McDonnell Douglas Corp. | Microbial Load Monitor | B75-10167 | JSC |
| J. J. Stiffler and A. H. Van Doren, Raytheon Co. | A Hybrid General-Purpose Bit Synchronizer | B75-10169 | JSC |
| S. Witz, C. Linnecke and W. Hartung, AMB Co. | Continuous Detection of Viable Micro-Organisms by Chemiluminescence | B75-10170 | JSC |
| G. C. Schmidt, Lockheed Electronics Co. | System for Simultaneous, Bidirectional Data Transmission | B75-10171 | JSC |
| J. C. Ryan and R. Chu, Rockwell International Corp. | Trimetric Scale for Drafting Machines | B75-10172 | JSC |
| F. S. Dawn and T. J. Ballentine, JSC, and R. E. Bishop and C. R. Rousseau, Rockwell International Corp. | Lightweight Ducts Fabricated from Reinforced Plastics and Elastomers | B75-10173 | JSC |
| Gordon L. Juvinall, Ernst M. Cohn, Aiji A. Uchiyama and Harvey A. Frank, Caltech/JPL | Nongassing NiCd Battery Cell | B75-10174 | NaPO |
| Shalhav Zohar, Caltech/JPL | Fast Fourier Transformation Computer Using Fast Counters | B75-10175 | NaPO |
| Lien C. Yang, Caltech/JPL | Compact Laser Through Improved Heat Conductance | B75-10176 | NaPO |
| John W. Fish, Caltech/JPL | Implantable Prosthetic Pump Boots Blood Pressure: A Concept | B75-10177 | NaPO |
| Rindge Shima, Caltech/JPL | Improved Multiple-Target Sputtering Equipment | B75-10178 | NaPO |
| Alan R. McDougal and Cledith E. Aardahl, Caltech/JPL | Three-Dimensional Models Aid Visualization of Engineering Drawings | B75-10179 | NaPO |
| Macgregor S. Reid, Robert A. Gardner and Charles T. Stelzried, Caltech/JPL | New Broadband Square-Law Detector | B75-10180 | NaPO |
| J. B. Stephens and C. G. Miller, Caltech/JPL | A Two-Degree Kelvin Refrigerator | B75-10181 | NaPO |
| Katsunori Shimada, Caltech/JPL | Economical Solar-Heating or Cooling System with New Solar-Energy Concentrators | B75-10182 | NaPO |
| Philip I. Moynihan, Caltech/JPL | High-Power CW Laser Using Hydrogen-Fluorine Reaction | B75-10183 | NaPO |

**Woman Engineer Takes Part in Studies**—Alberta W. King, an aerospace engineer in the Systems Dynamics Laboratory at the Marshall Space Flight Center, is involved in simulation studies of Space Shuttle and Space Tug rendezvous and docking procedures. At present, she is helping to set up a simulator, using a computer as a full-scale cockpit that has an animated video screen for projecting docking scenes. A petite redhead with a Master's degree in industrial engineering, she is twice a grandmother.

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### A Zeroing in on Windmills as an Energy Source

Energy shortages in recent years have caused this nation to reassess all existing sources and to look for others, both to take care of the present emergency and to meet future needs.

One potential source on which attention was focused has been the windmill. This device dates far back into history, having been used for grinding grain, pumping water, reclaiming land, sawing wood and, in recent years, making electricity. During the 1930s, it underwent a brief revival, then waned during the next two decades because it could not meet cost competition from such national resources as gas and oil. Now the spotlight is back on it, with the goal production of electricity at a cost possibly as low as two cents per kilowatt hour.

In 1973, the National Science Foundation was given the responsibility of planning and executing a sustained wind energy program, an assignment in January, 1975, turned over to the newly-formed Energy Research and Development Administration. Meanwhile, it was recognized that one of the first steps to be taken would be that of building a windmill that could be used for test purposes.

With NASA taking an active interest in the program, decision soon was made to bring Lewis Research Center into the picture by having it apply its expertise in aerodynamics, materials, electric power systems, and management techniques to the matter of producing the necessary windmill.

The work at LeRC was carried on so diligently that in August of this year, the windmill was completed at the Plum Brook Station near Sandusky, Ohio—a rotor consisting of two bladés 125 feet in diameter, capable of operating at 40 revolutions per minute in an 18-mile wind and generating 133 kilowatts of power, enough to supply the electrical needs of 30 average homes. It stands on a 100-foot tower and is the largest in the world today, though not the largest ever built. Its operation is automatic, starting and stopping as the wind blows. Eventually it will be tied directly into the local utility grid, the Ohio Edison Co.

Experiments with the new device are just beginning, but the technicians assigned to it are confident they are on the right track. One of them commented recently: "I would venture to say that by the year 2000 wind turbines very likely could be producing about five to ten percent of our total electrical requirements."

Major breakthroughs are not required, they say. All that is needed is good engineering design to get costs down, something LeRC has been noted for over the years.

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